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SUBSTITUTE SPECIFICATION

SPECIFICATION

TITLE

“SIEVE JIGGER”

BACKGROUND OF THE INVENTION

The invention relates to a sieve jigger for sorting solid material mixtures, such as raw coal or other minerals, in a separating liquid, such as water, according to density, in particular for the pre-separation of tailings, comprising a rocker that can pivot in the water bath and carries the sieved-product carrier and the sieved-product, which rocker executes an upward stroke by way of a pivotedly connected hydraulic cylinder and a downward stroke by letting it fall under the force of gravity.

From the leaflet 4-230d of KHD Humboldt Wedag AG of June 1989 the so-called ROMJIG sieve jigger is known for the pre-separation of tailings from raw coal. The jigging takes place in a water bath. The loosening of the material required for the sorting according to density is produced by the lifting or pivoting upward and dropping down of a rocker which is pivotally mounted in the water bath and carries the sieved-product carrier and the product. The lower specific density coal and the higher specific density tailings are separately discharged from the jigging machine by a lifting wheel.

With the known sieve jigger, the upward pivoting movement, i.e., the upward stroke of the sieved-product rocker, takes place by hydraulic oil flowing into a single-acting hydraulic cylinder which engages the rocker. On reaching a lifting height of, for example, 300 to 400 mm, the rocker is allowed to drop and moves downwards again as a result of gravity and its own mass (including the sieved-product) of, for example, 4000 to 5000 kg. In doing so the loaded rocker at the end of its downward movement falls onto at least two hydraulic vibration dampers, which are able to transmit the forces released during the falling down of the rocker in an as jolt-free manner as possible. It was found that with this type of rocker drive the lifting frequency of the rocker is limited to approximately 40 strokes per minute. In addition, the vibration dampers are subject to wear and an undesirable heat generation.

SUMMARY OF THE INVENTION

The aim of the invention is to provide a sieve jigger comprising a sieved-product rocker that can be pivoted upwards and downwards, the lifting displacement and/or lifting frequency of which can be controlled beyond previously accepted limits and which does not require vibration dampers that are subject to wear.

With the sieve jigger according to the invention, the drive of the sieved-product rocker takes place neither with a usual single-acting hydraulic cylinder nor with a usual so-called double-acting cylinder. On the contrary, the drive of the sieve jigger according to the invention is designed as a lifting and braking cylinder which uses one single cylinder working chamber to perform various tasks. Connected to this cylinder working chamber is a hydraulic oil supply and evacuation conduit with an integrated proportional control valve. The lifting and braking cylinder is furthermore equipped with a measuring device for the displacement of the cylinder piston, the measuring signal of which is fed by way of a displacement sensor to a governor, which is operatively connected to the proportional control valve in order to control the upward movement and the downward movement and thus the lifting height and/or lifting frequency of the rocker.

The control intervention on the proportional regulating valve takes place here in such a way that for the pivoting upwards of the rocker, hydraulic oil is fed through the hydraulic oil supply and evacuation conduit into the working chamber of the lifting and braking cylinder until before the upper dead point of the piston is reached, and for lowering the rocker, it first falls in free fall while displacing hydraulic oil from the cylinder working chamber and discharging hydraulic oil through the same conduit, followed by hydraulic braking of the cylinder piston before the lower dead point is reached. The hydraulic drive cylinder

accordingly at the same time takes on the function of a controlled vibration damping, i.e., the rocker does not require its own mechanical vibration dampers for limiting the lifting displacement of the rocker.

The working cycle of the lifting and braking cylinder consists, therefore, of the lifting phase of the rocker, the free-fall phase of the rocker and the braking phase of the rocker, wherein all three phases can be controlled independently. The sieved-product rocker can, therefore, be controlled within respect to its lifting displacement and/or its lifting frequency beyond previously accepted limits, and the operation of the sieve jigger can be optimized further with regard to the throughput and/or its separation effect depending upon the respective sorting process, the respective mineral mixtures that have to be sorted, etc.

The invention and its further characteristics and advantages will be explained in more detail in the following with reference to the exemplified embodiment illustrated diagrammatically in the figures.

BRIEF DESCRIPTION OF THE DRAWING

The invention and its further features and advantages are described in greater detail with the aid of the embodiments schematically represented in the drawing.

Fig. 1. illustrates diagrammatically in vertical section a sieve jigger for the density sorting of raw coal in operation.

Fig. 2. shows schematically, in greater detail, the drive of the sieved-product rocker using a hydraulic lifting and braking cylinder, and

Fig. 3. shows the upward and downward movement of the sieved-product rocker of Figure 2 seen at the connection point of the lifting and braking cylinder, in a diagram in which the lifting height (h) is plotted against time (t).

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With the sieve jigger of Figure 1 the density sorting of the charged raw coal 10 takes place in a water bath 11. The loosening of the material required for the sorting is produced by the pivoting upwards and downwards of a sieved-product rocker 12 with a pivoting axis 13 located in the water bath 11. Linked to a crossbar of the rocker 12 at a linkage point 14 is the piston rod 15 of a hydraulic cylinder 16, which according to the invention is designed as a lifting and braking cylinder. The lifting height of the rocker, representing part of a circular arc, is indicated by the double arrow 17. At a mass of the rocker 12 including the material of approximately 4000 to 5000 kg, the lifting height 17 of the rocker amounts, for example, to approximately 300 to 400 mm at a lifting frequency of, for example, 40 strokes per minute.

The transport of the to be sorted material 10 through the sieve jigger takes place by the movements of the rocker 12 as well as by the slope pressure of the material. Whereas the tailings 18 with the higher specific density are drawn off via a discharge roller 19, the coal with the lighter specific density as well as the middlings 20 are drawn off through a separate chute. Both products, i.e., tailings 18 and coal/middlings 20 are discharged from the jigger separately from one another by a twin lifting wheel 21 and in doing so are de-watered, while the fines 22 that have fallen through the sieved-product carrier into the drum are discharged from the jigger at the bottom and fed to a fines sorting process.

Integrated into the pivotedly mounted lifting and braking cylinder 16, shown on a larger scale in Figure 2, is a displacement measuring device 23 for the piston 24, wherein the measuring signal is passed via a signal line to a displacement sensor 25, which in turn via a signal line 26 is connected to a governor 27. Connected to the working chamber of the cylinder 16 is a hydraulic oil supply and evacuation conduit 28, in which a proportional control valve 29 is integrated. The lifting and braking cylinder 16 is operatively connected via the governor 27 via a further signal line 30 to the proportional control valve 29 in order to control the upward movement and the downward movement and accordingly the lifting height 17 and/or the lifting frequency of the sieved-product rocker 12.

As can clearly be noted from the operating diagram of Figure 3, the operating cycle of the lifting and braking cylinder 16 consists of three phases, i.e. the lifting phase of the rocker 12, the free-fall phase of the rocker and a braking phase of the rocker, wherein all three phases can be controlled independently. The difference between the upper and lower piston

position of the lifting and braking cylinder 16 corresponds to the lifting displacement 17 of the rocker 12 of, for example, 350 mm, wherein the lifting displacement range lies between the limits of the upper dead point OT and the lower dead point UT of the cylinder piston 24.

The proportional control valve 29 is arranged in the hydraulic oil circuit between the motor-driven hydraulic oil pump 31 of the hydraulic unit and the working chamber of the lifting and braking cylinder 16.

The control intervention on the proportional control valve 29 takes place in such a way that for the lifting, i.e., the upward movement of the rocker 12, hydraulic oil is fed through the hydraulic oil supply and evacuation conduit 28 into the working chamber of the lifting and braking cylinder 16 until before the upper dead point OT is reached. In order to lower the rocker 12, it first falls in free-fall during which hydraulic oil is displaced from the working chamber of the cylinder and hydraulic oil is discharged through the same conduit 28, followed by a hydraulic braking of the cylinder piston 24 before the lower dead point UT is reached.

According to the diagram of Figure 3, the time for a working cycle of the lifting and braking cylinder 16 at a rocker lifting displacement of 350 mm is 1.36 seconds, which corresponds to a lifting frequency of $f = 44$ cycles per minute. An electronic timing generator system 32 included in the proportional control valve 29 ensures an accurately timed supply of hydraulic oil to the hydraulic oil conduit 28 for the purpose of maintaining the three successive periodic time intervals for the lifting phase, free-fall phase and braking phase of the rocker 12, wherein these three phases in each instance result in a working cycle of the lifting and braking cylinder 16.

As is apparent from the foregoing specification, the invention is susceptible of being embodied with various alterations and modifications which may differ particularly from those that have been described in the preceding specification and description. It should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.